



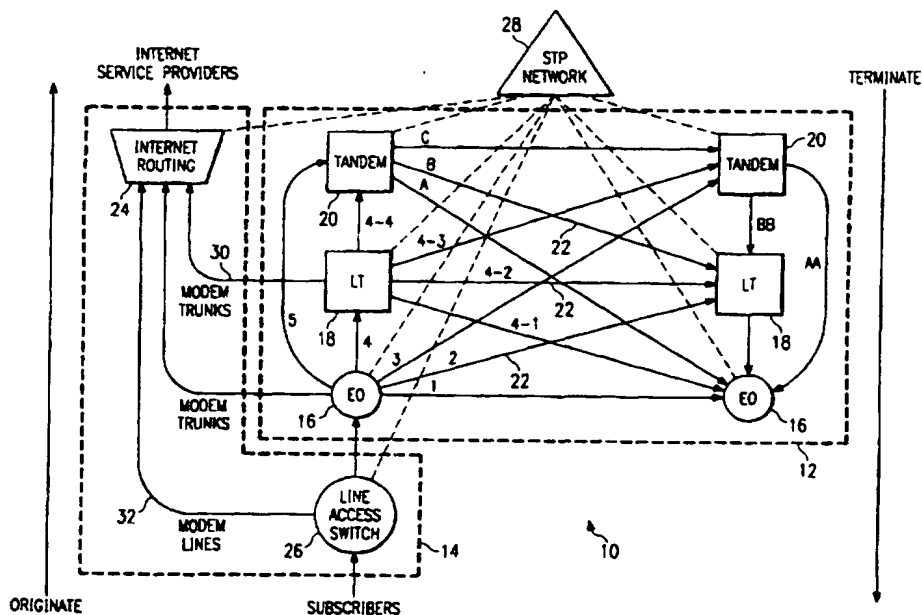
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 11/04		A2	(11) International Publication Number: WO 97/38551
			(43) International Publication Date: 16 October 1997 (16.10.97)
(21) International Application Number: PCT/US97/05387		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 1 April 1997 (01.04.97)			
(30) Priority Data: 60/014,862 4 April 1996 (04.04.96) US 08/777,817 31 December 1996 (31.12.96) US			
(71) Applicant: DSC TELECOM L.P. [US/US]; 1000 Coit Road, Plano, TX 75075 (US).			
(72) Inventors: DESCHAIINE, Stephen, A.; 3326 Bluffview, Garland, TX 75043 (US). TRAUPMAN, Edward, P.; 490 Hackberry Drive, Fairview, TX 75069 (US). WARD, Ronald, L.; 3823 Ridgcrest Drive, Flower Mound, TX 75028 (US). HAGER, Kevin, W.; 3324 Jameston Drive, Flower Mound, TX 75028 (US).			
(74) Agent: FISH, Charles, S.; Baker & Botts, L.L.P., 2001 Ross Avenue, Dallas, TX 75201-2980 (US).		Published <i>Without international search report and to be republished upon receipt of that report.</i>	

(54) Title: METHOD AND APPARATUS FOR ROUTING INTERNET CALLS

(57) Abstract

A telecommunications network (10) includes a public switched telephone network (12) and an Internet data network (14). The Internet data network (14) includes an Internet routing element (24) and a line access switch (26). The Internet routing element (24) is coupled to end office switches (16) and local switches (18) of the public switched telephone network (12) by modem trunks (30). The modem trunks (30) provide the Internet routing element (24) with Internet calls re-routed from the public switched telephone network (12) to prevent the Internet calls from congesting trunks (22) of the public switched telephone network (12). The Internet calls are received at an ATM multiplexer (58) within the Internet routing element (24). The ATM multiplexer (58) includes a pool of modems (60) that converts the analog signal on the modem trunks (30) into digital data. The ATM multiplexer (58) includes an ATM cell adaptation unit (66) that converts the digital data into ATM cells for transmission to an Internet Service Provider (42) over an ATM network (48). The ATM multiplexer (58) generates addressing information for the ATM cells through interworkings with signaling protocols of a signal transfer point network (28) and an SS-7 signaling network (44) in order to determine the destinations for the Internet calls. The line access switch includes a similar ATM multiplexer (94) to re-route Internet calls prior to entering the public switched telephone network (12).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

METHOD AND APPARATUS FOR ROUTING INTERNET CALLS

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to telecommunications signal processing and more particularly to a method and apparatus for routing Internet calls.

5

BACKGROUND OF THE INVENTION

As access demand on the Internet or with on-line services grows, a proportional increase in the stress on telecommunications equipment occurs to support the access demand. Subscribers typically access the Internet through one or more Internet Service Providers. Each Internet Service Provider is generally accessed by subscribers using discrete local telephone numbers that provide broad coverage into a public switched telephone network. Access to the Internet Service Provider is typically a free local call where the local exchange carrier receives no revenues for the telephone usage. Internet Service Providers terminate in end offices of the public switched telephone network using conventional subscriber numbering plans. No control exists as to Internet subscriptions, local telephone number assignments for Internet Service Providers, or locations of Internet Service Providers. Internet traffic between subscribers and Internet Service Providers is mainly routed through the existing public switched telephone network over the same trunks that carry voice, facsimile, and data calls.

10

15

20

25

Traditional network engineering traffic guidelines do not take into consideration the longer than average hold times of Internet calls. Most telecommunications equipment were designed based on an average call holding time of three to five minutes. However, average call holding times for Internet calls is significantly longer. Current estimates are that Internet and similar services have raised the total average call holding time to over ten minutes. This is expected to increase as the Internet continues to grow. Current end office switches within the public switched telephone network are not configured to support extended access to the Internet. The increased average call holding times of Internet calls place a strain on the public switched telephone network that affects the quality of service provided to and expected by the local subscriber. The public switched telephone network is no longer able to provide effective universal services to its customers while meeting the growing Internet demands.

Increased average call holding times decrease the carrying capacity of trunks and, because the calls are typically free, decrease toll call revenue per trunk as a result of the increased content per call. Though additional trunks may be installed to support the increase in call holding times, such additions increase trunk group costs and operating expenses. Congestion occurs within the public switched telephone network as customers attempt and re-attempt their calls. Service quality suffers resulting in increased customer dissatisfaction and increased service costs. Expensive and complex switch reconfigurations would be needed in order to relieve the congestion on the public switched telephone network caused by Internet calls. Therefore, it is desirable to reduce the congestion in the public switched telephone network caused by the long holding times of Internet calls.

SUMMARY OF THE INVENTION

From the foregoing, it may be appreciated that a need has arisen for a technique of avoiding congestion on a public switched telephone network caused by the long hold times of Internet calls. In accordance with the present invention, a method and apparatus of routing Internet calls are provided that substantially eliminate or reduce disadvantages and problems associated with conventional processing of Internet calls.

According to an embodiment of the present invention, there is provided an apparatus for routing Internet calls that includes a pool of modems to convert the analog signals of Internet calls re-routed from a public switched telephone network into a digital data format. An ATM cell adaptation unit converts the digital data format into ATM cells. A network interface transports the ATM cells to an Internet Service Provider over an ATM network separate from the public switched telephone network. The ATM cells for the Internet calls include addressing information generated by an ATM addressing unit in conjunction with the signaling protocols of an SS-7 network for determining the appropriate destination of the Internet calls.

The present invention provides various technical advantages over conventional Internet call processing. For example, one technical advantage is to re-route Internet calls off of the public switched telephone network. Another technical advantage is to avoid placing Internet calls onto the public switched telephone network. Yet another technical advantage is to transport Internet calls in asynchronous transfer mode cell format over an asynchronous transfer mode network to an Internet Service Provider. Other technical advantages are readily apparent to one skilled in the art from the following figures, descriptions, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings, wherein like reference numerals represent like parts, in which:

FIGURE 1 illustrates a block diagram of a telecommunications switched network;

FIGURE 2 illustrates a block diagram of an Internet call through the telecommunications switched network;

FIGURE 3 illustrates another view of the telecommunications switched network;

FIGURES 4A-C illustrate call control procedures at different congestion points within the telecommunications switched network;

FIGURE 5 illustrates a block diagram of an Internet routing element within the telecommunications network;

FIGURE 6 illustrates a block diagram of an asynchronous transfer mode multiplexer of the Internet routing element;

FIGURE 7 illustrates a block diagram of a line access switch within the telecommunications network; and

FIGURE 8 illustrates a process flow for processing a call through the line access switch.

DETAILED DESCRIPTION OF THE INVENTION

FIGURE 1 is a block diagram of a telecommunications switched network 10. Telecommunications switched network 10 includes a local public switched telephone network 12 and an Internet data network 14. Public switched telephone network 12 includes a plurality of end offices 16, a plurality of local tandem switches 18, and a plurality of tandem switches 20. End offices 16, local tandem switches 18, and tandem switches 20 are interconnected by a

plurality of trunks 22 in order to provide adequate means for transporting telecommunications information from an originating subscriber to a destination subscriber in communication with end offices 16. Internet data network 14 includes Internet routing elements 24 that perform switching functions for Internet Calls re-routed from public switched telephone network 12. Internet data network 14 may also include line access switches 26 coupled to Internet routing elements 24 and public switched telephone network 12. A signal transfer point network 28 provides control, management, and administrative functions for public switched telephone network 12 and Internet data network 14.

Conventional operation of public switched telephone network 12 provides for routing of Internet calls through the same configuration of trunks 22 used to route voice, facsimile, and data calls. In order to avoid installing additional trunks 22 to relieve trunk congestion within public switched telephone network 12, avoid installing more cross-points to relieve concentrator congestion within end offices 16, and avoid replacing existing equipment within public switched telephone network 12, all necessary to handle the longer hold times caused by Internet calls, Internet data network 14 provides a means to re-route Internet calls and eliminate the effect Internet calls have on public switched telephone network 12. Internet calls may be re-routed onto modem trunks 30 from either local tandem switches 18 or end offices 16. Internet calls may also be re-routed away from public switched telephone network 12 onto modem lines 32 by line access switches 26.

FIGURE 2 shows how an Internet call is transferred from a local subscriber 40 to an Internet Service Provider 42 within telecommunications switched network 10 after entering public switched telephone network 12. For

unloading Internet calls from trunks 22 within public switched telephone network 12 to Internet data network 14, signal transfer point network 28 works with local tandem switches 18, end offices 16, and Internet routing elements 24 to assign modem trunks 30 and determine the destination for routing the Internet call based on signaling protocols of an SS-7 network 44. Conventional processing and routing is performed within public switched telephone network 12 of Non-Internet calls. Public switched telephone network 12 may also process and route Internet calls in the event of problems occurring within Internet data network 14. End office 16 or local switch 18 accepts the Internet call and routes the Internet call to an appropriate Internet routing element 24. Internet routing element 24 terminates the analog signals received from public switched telephone network 12 and adapts the call into asynchronous transfer mode cell format. The asynchronous transfer mode cells are multiplexed for transmission across an asynchronous transfer mode network 46 to the appropriate Internet Service Provider 42.

FIGURE 3 is another view of a telecommunications switched network 110 showing potential congestion points due to Internet traffic. Telecommunications switched network 110 is shown separated into a public switched telephone network 112 and Internet data network 114. For conventional operation, calls originating from a telephone subscriber 139 or a computer subscriber 140 and destined for an information service provider 142 are routed through public switched telephone network 112. Public switched telephone network 112 includes local access switch 126, originating end office switch 116, a tandem switch network 120, and terminating end office switch 117, all under the control and supervision of a signal transfer point 128. Since calls destined for information service provider 142

occupy available resources of public switched telephone network 112 due to the long call holding times, such as for Internet access, congestion points occur within public switched telephone network 112. Congestion occurs at the subscriber side at originating end office switch 116, congestion occurs in the trunk network at tandem switch network 120, and congestion occurs at the terminating end at terminating end office switch 117. The congestion on public switched telephone network 112 will exceed engineered switch and network trunking arrangements, resulting in call denial. Data subscribers and voice subscribers may experience no dialtone, slow dialtone, and all trunks busy signals due to the degradation in the network quality.

In order to alleviate the congestion on public switched telephone network 112, calls identified as originating from a subscriber 139 or 140 and destined for an information service provider 142 are redirected from public switched telephone network 112 onto Internet data network 114. Internet data network 114 includes a data switch network 146 that receives line side redirection of data calls from local access switch 126 to alleviate the subscriber side congestion and originating end office switch 116. Data switch network 146 also receives trunk side redirection of calls from originating end office switch 116 through an Internet routing element 124 in order to alleviate trunk network congestion at tandem switch network 120. Data switch network 146 also receives trunk side redirection of data calls from tandem switch network 120 in order to alleviate congestion at terminating end office switch 117 through an Internet routing element 124. Data switch network 146 then appropriately routes data calls to information service provider 142. Identification and redirection of data calls is performed by signal

transfer point 128 through an SS7 messaging protocol. Internet routing elements 124 are used for grooming and transport of data call traffic onto data switch network 146.

5 In order to relieve subscriber side congestion at originating end office switch 116, a call destined for information service provider 142 is identified in order to successfully divert the data call away from public switch telephone network 112. The identification process is
10 performed by signal transfer point 128. During a normal call processing sequence, line access switch 126 converts the analog POTS signal originating from a subscriber 139 or 140 to a digital DS0 signal and forwards that signal to originating end office switch 116 to begin call processing.
15 Call requests that cannot be locally connected generate an SS7 message that is forwarded to signal transfer point 128. The call is completed when an SS7 message arrives back from signal transfer point 128 with instructions on routing. When signal transfer point 128 determines that the call is
20 being placed to information service provider 142 during its digital analysis process on the called party address, it initiates a coordinating sequences of messages that allows originating end office switch 116 to disconnect the call, and free the matrix and free the trunk resource between
25 line access switch 126 and originating end office switch 116. Signal transfer point 128 directs line access switch 126 to divert the call from originating end office switch 116 trunk resources to another resource, such as a dedicated DS0/DS1 circuit or a modem from internal pool
30 with an ATM connection, that bypasses public switch telephone network 112. Data switch network 146 then cross connects the resources between line access switch 126 and information service provider 142. Line access switch 126 continues to monitor the subscriber drop throughout the

call, as would be performed for any call. Upon detecting that the subscriber goes on-hook, line access switch 126 informs originating end office switch 116 so that the subscriber line can be once again made available for incoming and outgoing calls. Line access switch 126 also informs signal transfer point 128 so that the dedicated DS0/DS1 circuit or ATM modem connection can be torn down and made available for other calls. If the line disconnect originates at information service provider 142, signal transfer point 128 notifies originating end office switch 116 and line access switch 126 in order to update their call status. All control information exchanges between signal transfer point 128, line access switch 126, and originating end office switch 116, are accomplished using standard signaling messages (such as Q.931) over standard interfaces.

Though line side redirection alleviates congestion directly at originating end office switch 116 and indirectly at tandem switch network 120 and terminating end office switch 117, trunk side redirection is performed to directly eliminate trunk network congestion at tandem switch network 120 and terminating end office switch 117. Trunk side redirection is performed at originating end office switch 116 to adjust congestion at tandem switch network 120 and trunk side redirection is also performed at tandem switch network 120 to address congestion at terminating end office 117.

In order to successfully divert data calls from the trunk network of public switched telephone network 112, signal transfer point 128 identifies calls originating from subscriber 16 or 18 and destined for information service provider 142. During a normal call processing sequence, originating end office switch 116 detects an off-hook condition at subscriber 16 or 18 and generates an SS7

message that is forwarded to signal transfer point 128 for call requests that cannot be locally connected. The call is completed when an SS7 message is returned from signal transfer point 128 with instructions on routing. The call is ended when originating end office switch 116 detects the calling end going on-hook and thus terminates the call. When signal transfer point 128 determines that the call is being placed to information service provider 142, it directs originating end office switch 116 to divert the call to Internet routing element 124. Internet routing element 124 places the call on a resource, such as a dedicated DS0/DS1 circuit or a modem from an internal pool with an ATM connection, that bypasses public switched telephone network 112. Data switch network 146 connects the resource between originating end office switch 116 and information service provider 142. Originating end office switch 116 continues to monitor the subscriber drop throughout the call. Once it detects that a subscriber has gone on-hook, originating end office switch 116 signals signal transfer point 128 through the SS7 network so that the call's connection can be torn down and the resources made available for other calls. If the disconnect originates at information service provider 142, signal transfer point 128 detects the condition and notifies originating end office switch 116 so that it can update its call status.

Signal transfer point 128 works similarly with tandem switch network 120 to redirect data calls from public switched network 112 onto Internet data network 114 in order to alleviate congestion at terminating end office switch 117.

Signal transfer point 128 determines where an Internet call is to be redirected by maintaining a call detail record of calls through telecommunications switched network

110. For example, subscribers identified as heavy Internet subscribers by signal transfer point 128 may be line side redirected at line access switch 126 so that they are removed from public switched telephone network 112 at an earliest possible point in order to avoid congestion. Those subscribers identified as normal Internet subscribers by signal transfer point 128 may be redirected off of public switched telephone network 112 at the trunk side of originating end office switch 116. Those subscribers identifies as low density Internet subscribers by signal transfer point 128 may traverse through public switched telephone network 112 with redirection not occurring until somewhere within tandem switch network 120. In this manner, intelligent rerouting of data calls can occur to avoid congestion and provide smooth call routing within public switched telephone network 112.

Signal transfer point 128 may attempt to redirect the Internet call away from public switched telephone network 112 at any and all of the redirection points discussed above. If a designated route to Internet data network 114 is busy or not available, the Internet call overflows for routing back through public switched telephone network 112. Once the Internet call overflows back to public switched telephone network 112, the Internet call may be routed through alternate paths to Internet data network 114 in higher level offices, once again achieving the goal of removing Internet traffic from the public switched telephone network 112. The Internet call traverses through the entire public switched telephone network 112 only as a last resort in the event there are no other resources available to redirect the Internet call onto Internet data network 114.

FIGURES 4A through 4C show the call control for redirecting Internet calls off of public switched telephone

network 112. FIGURE 4A shows the redirection of a line side Internet call at line access switch 126. An Internet call originates from subscriber 140 and proceeds through line access switch 126 to originating end office switch 116. Originating end office switch 116 provides a dial tone for subscriber 140 and collects the digits entered by subscriber 140. Originating end office switch 116 queries signal transfer point 128 through SS7 signaling. Signal transfer point 128 receives the SS7 message at an SS7 interface 150 and performs a lookup of routing instructions within a signal control point 152 in conjunction with an administration unit 153. Signal control point 152 returns a translated called number to originating office switch 116 through SS7 interface 150. Originating end office switch 116 routes the call based on the translated called number response. Originating end office switch 116 sets up an ISUP call between line access switch 126 and a master controller 154 of signal transfer point 128. Master controller 154 passes control and routing information for information service provider 142 to line access switch 126. Line access switch 126 provides an interface to data switch network 146 and routes the Internet call through data switch network 146 to information service provider 142. Line access switch 126 issues a subscriber busy signal to originating end office switch 116 to indicate that subscriber 18 is off hook.

FIGURE 4B shows redirection of a trunk side Internet call at originating end office switch 116. An Internet call originates from subscriber 140 to originating end office switch 116. Originating end office switch 116 provides dial tone and collects digits entered by subscriber 140. In response to the digits collected, originating end office switch 116 queries signal transfer point 128 through an SS7 messaging protocol. Signal

transfer point 128 receives the SS7 message at SS7 interface 150 and obtains routing instructions from signal control point 152 in conjunction with administration unit 153. Signal control point 152 returns a translated called number to originating end office switch 116 through SS7 interface 150. Originating end office switch 116 sets up the route for the Internet call based on this response. Originating end office switch 116 sets up an ISUP call between master controller 154 of signal transfer point 128 and an Internet routing element 144. Master controller 154 passes control information to Internet routing element 154. Internet routing element 154 establishes the connection for the Internet call onto data switch network 146 and provides the interface with data switch network 146.

FIGURE 4C shows redirection of a trunk side Internet call at tandem switch network 120. Subscriber 140 originates an Internet call through originating end office switch 116 and to tandem switch network 120. Tandem switch network 120 queries signal transfer point 128 through the SS7 messaging protocol. The SS7 message received at SS7 interface 150 and routing instructions are obtained from signal control point 152. Signal control point 152 returns a translated called number to tandem switch network 120 through SS7 interface 150. Tandem switch network 120 sets up an ISUP call between its associated Internet routing element 144 and master controller 154 of signal transfer point 128. Master controller 154 obtains routing information for information service provider 142 from signal control point 152, in conjunction with administration unit 153, and passes control and connection information to Internet routing element 144. Internet routing element 144 establishes the connection and provides the interface with data switch network 146. The Internet

call is then appropriately redirected through data switch network 146 to information service provider 142.

FIGURE 5 is a block diagram of an Internet routing element 24. Internet routing element 24 includes an administration subsystem 50, a matrix fabric subsystem 52, network terminators 54, and a resource subsystem 56. Administration subsystem 50 provides control, maintenance, test access, and timing functions for Internet routing element 24. Network terminators 54 provide the signal interfaces to and from telecommunications switched network 10. Matrix fabric subsystem 52 provides the switching and cross-connect functions for Internet routing element 24. Resource subsystem 56 provides substrate data multiplexing, multi-point junction, digital matrix bridge, and ATM multiplexing functions. Routing and transportation of Internet calls is performed through ATM multiplexer 58.

FIGURE 6 is a block diagram of ATM multiplexer 58. ATM multiplexer 58 includes a pool of modems 60, a control processor 62, an ATM addressing unit 64, an ATM cell adaptation unit 66, a backplane interface 67, and a network interface 68. In operation, an Internet call is routed to ATM multiplexer 58 over a backplane 70 of Internet routing element 24. The Internet call is processed by the appropriately assigned modem 60 in order to convert from analog format into digital format. The digital data generated by modem 60 is converted into ATM cells by ATM cell adaptation unit 66. Addressing information is placed into the ATM cells by ATM addressing unit 64 in response to the determination of the destination by control processor 62. Control processor 62 communicates with signal transfer point network 28 to obtain the destination information from the signaling protocols of SS-7 network 44. Once the ATM cells have been generated and contain the appropriate addressing information, the ATM cells are transported to

and from ATM network 46 by network interface 68 or by backplane interface 67 through network terminators 54.

FIGURE 7 is a block diagram of a line access switch 26 to re-route Internet calls prior to entering public switched telephone network 12. Line access switch 26 includes a digital loop carrier central terminal 80 and a digital loop carrier remote terminal 82. Remote terminal 82 includes a channel bank assembly 84 to service wire line subscribers. Remote terminal 82 also includes a fiber bank assembly 86 to provide fiber optic connection services to subscribers through optical network units 88. A common control assembly 89 provides control and interface functions with central terminal 80 for channel bank assembly 84 and fiber bank assembly 86. Central terminal 80 includes a common control assembly 90 to provide control and interface functions with signal transfer point network 28 and remote terminal 82. Common control assembly 90 also interfaces with channel bank assemblies 92 and ATM multiplexer 94. Channel bank assemblies 92 provide communication to and from end office switch 16 of public switched telephone network 12. ATM multiplexer 94 provides the access for Internet calls to Interface routing element 24 and has a similar structure to that of ATM interface 58.

FIGURE 8 shows the process flow of calls through line access switch 26. At process step 100, a subscriber initiates a call that is routed through remote terminal 82 and central terminal 80 to end office switch 16. End office switch 16 determines at process step 102 whether the call is a trunk call for public switched telephone network 12. If not, end office switch 16 performs local call processing at process step 103. If the call is a trunk call, signal transfer point network 28 determines at process step 104 whether the call is an Internet call. If not, end office switch 16 performs normal call processing

over public switched telephone network 12 at process step 103. If the call is an Internet call, signal transfer point network 28 determines at process step 106 whether an Internet route is available for the Internet call. If not,
5 end office switch 16 performs normal call processing of the Internet call over public switched telephone network 12 at process step 103.

If the subscriber is making an Internet call and an Internet route is available, the pool of modems within ATM
10 multiplexer 94 is appropriately configured and addressing information for the ATM cells is generated at process step 108. ATM multiplexer 94 determines at process step 110 whether the pool of modems was successfully configured to handle the Internet call. If not, then process flow
15 proceeds back to process step 106 to determine if a different Internet route is available to handle the Internet call. If the pool of modems was properly configured to handle the Internet call, central terminal 80 of line access switch 26 connects the subscriber to the
20 appropriate modem at process step 112. Central terminal 80 disconnects the Internet call from end office switch 16 such that the Internet call now will not be processed over public switched telephone network 12.

Central terminal 80 determines at process step 114
25 whether the subscriber was successfully connected to the appropriate modem. If not, then process flow proceeds back to process step 106 to determine if a different Internet route is available to handle the Internet call. If subscriber to modem connection was successful, ATM
30 multiplexer 94 begins generating and transporting ATM cells to ATM network 46 either directly or through backplane interface 67 and network interface 68 of Internet routing element 24. Central terminal 80 associates a do not disturb service with the subscriber at process step 116 and

informs end office switch 16 of this condition. Central terminal 30 monitors the Internet call for disconnection by the subscriber at process step 118 and appropriately terminates the do not disturb service upon completion of the call.

In summary, an Internet calls are routed away from the public switched telephone network in order to avoid congestion caused by the longer than average hold times of Internet calls. Internet calls are routed to an Internet data network that includes an Internet routing element and a line access switch. The Internet routing element and the line access switch employ ATM multiplexers that connect the Internet calls to a pool of modems and convert the digital data generated by the modems into ATM cells for transmission to Internet Service Providers over an ATM network. The ATM multiplexers work with a signal transfer point network and an SS-7 network to generate the addressing information for the ATM cells.

Thus, it is apparent that there has been provided, in accordance with the present invention, a method and apparatus for routing Internet calls that satisfy the advantages set forth above. Although the present invention has been described in detail, it should be understood that various changes, substitutions, and alterations can be made herein. For example, though the present invention has been described with reference to Internet calls, other types of calls with longer than average holding times may be routed in a similar manner. Other examples are readily ascertainable by one skilled in the art and may be made without departing from the spirit and scope of the present invention.

WHAT IS CLAIMED IS:

1. A telecommunications network, comprising:

5 a line access switch operable to transfer telecommunications signals for calls to and from a subscriber;

an originating end office switch operable to transfer telecommunications signals for calls routed to and from the line access switch;

10 a tandem switch network operable to transfer telecommunications signals for calls routed to and from the originating end office switch;

15 a terminating end office switch operable to transfer telecommunications signals for calls routed to and from the tandem switch network, the terminating end office switch operable to transfer telecommunications signals for calls routed to and from an information service provider;

20 a data network operable to transfer telecommunications signals for a call between the subscriber and the information service provider, the data network receiving the call originating from the subscriber and destined for the information service provider as redirected by any one of the line access switch, the originating end office switch, and the tandem switch network;

25 a signal transfer point operable to supervise call routing at the line access switch, the originating end office switch, the terminating end office switch, and the tandem switch network, the signal transfer point operable to identify the call originating from the subscriber and destined for the information service provider, the signal transfer point operable to provide call routing instructions to any one of the line access switch, the originating end office switch, and the tandem switch network to redirect the call over the data network

30

identified as originating from the subscriber and destined for the information service provider.

5 2. The telecommunications network of Claim 1, wherein the line access switch directs the call originating from the subscriber and destined for the information service provider to the originating end office switch in response to call routing instructions from the signal transfer point upon determination of congestion in a communication link
10 between the line access switch and the data network.

15 3. The telecommunications network of Claim 1, wherein the originating end office switch directs the call originating from the subscriber and destined for the information service provider to the tandem switch network in response to call routing instructions from the signal transfer point in an event of congestion in a communications link between the originating end office switch and the data network.
20

25 4. The telecommunications network of Claim 1, wherein the tandem switch network directs the call originating from the subscriber and destined for the information service provider to the terminating end office switch in response to call routing instructions from the signal transfer point in an event of congestion on a communication link between the tandem switch network and the data network.

30 5. The telecommunications network of Claim 1, wherein the signal transfer point uses SS7 messaging to identify and redirect the call originating from the subscriber and destined for the information service provider.

6. The telecommunications network of Claim 1, wherein the data network receives the call originating at the subscriber and destined for the information service provider from any of the line access switch, the originating end office switch, and the tandem switch network in an asynchronous transfer mode cell format, the data network transferring the call to the information service provider in the asynchronous transfer mode cell format.

7. A method of routing data calls in a public switched telephone network, comprising steps of:

receiving a call from a subscriber at a local line access switch;

determining whether the call is destined for an information service provider;

redirecting the call onto a data network and away from a public switched telephone network upon identifying the call as being destined for the information service provider, the data network transferring the call to the information service provider.

8. The method of Claim 7, further comprising steps of:

determining whether a communication link is available between the local line access switch and the data network;

directing the call from the local line access switch to an originating end office switch in the public switched telephone network when the communication link between the local line access switch and the data network is not available.

9. The method of Claim 8, further comprising steps of:

receiving the call from the local line access switch at an originating end office switch;

5 determining whether the call is destined for the information service provider;

redirecting the call to the data network and off of the public switched telephone network upon identifying the call as being destined for the information service provider.

10

10. The method of Claim 9, further comprising steps of:

determining whether a communication link is available between the originating end office switch and the data network;

15

directing the call from the originating end office switch to a tandem switch network in the public switched telephone network when the communication link between the originating end office switch and the data network is not available.

20

11. The method of Claim 10, further comprising steps of:

receiving the call from the originating end office switch at the tandem switch network;

25

determining whether the call is destined for the information service provider;

redirecting the call to the data network and off of the public switched telephone network upon identifying the call as being destined for the information service provider.

30

12. The method of Claim 11, further comprising steps of:

determining whether a communication link is available between the tandem switch network and the data network;

5 directing the call from the tandem switch network to a terminating end office switch in the public switched telephone network when the communication link between the tandem switch network and the data network is not available, the terminating end office switch providing
10 communication service to and from the information service provider.

13. The method of Claim 12, further comprising steps of:

15 receiving the call from the tandem switch network at the terminating end office switch;

directing the call to the information service provider, the call being routed from the subscriber to the information service provider over the public switched
20 telephone network when congestion exists or resources are unavailable to redirect the call to the data network.

14. A method of redirecting data calls at a line access switch, comprising steps of:

25 receiving a data call from a subscriber;

providing a through path for the data call to an originating end office switch;

receiving routing instruction for the data call;

30 establishing a redirect path for the data call to bypass the originating end office switch in response to the routing instructions;

placing the data call onto the redirect path.

15. The method of Claim 14, further comprising a step of:

providing the originating end office switch with a do not disturb message to indicate that the subscriber is not available for another call.

5

16. The method of Claim 14, further comprising the step of:

converting the data call into an asynchronous transfer mode format.

10

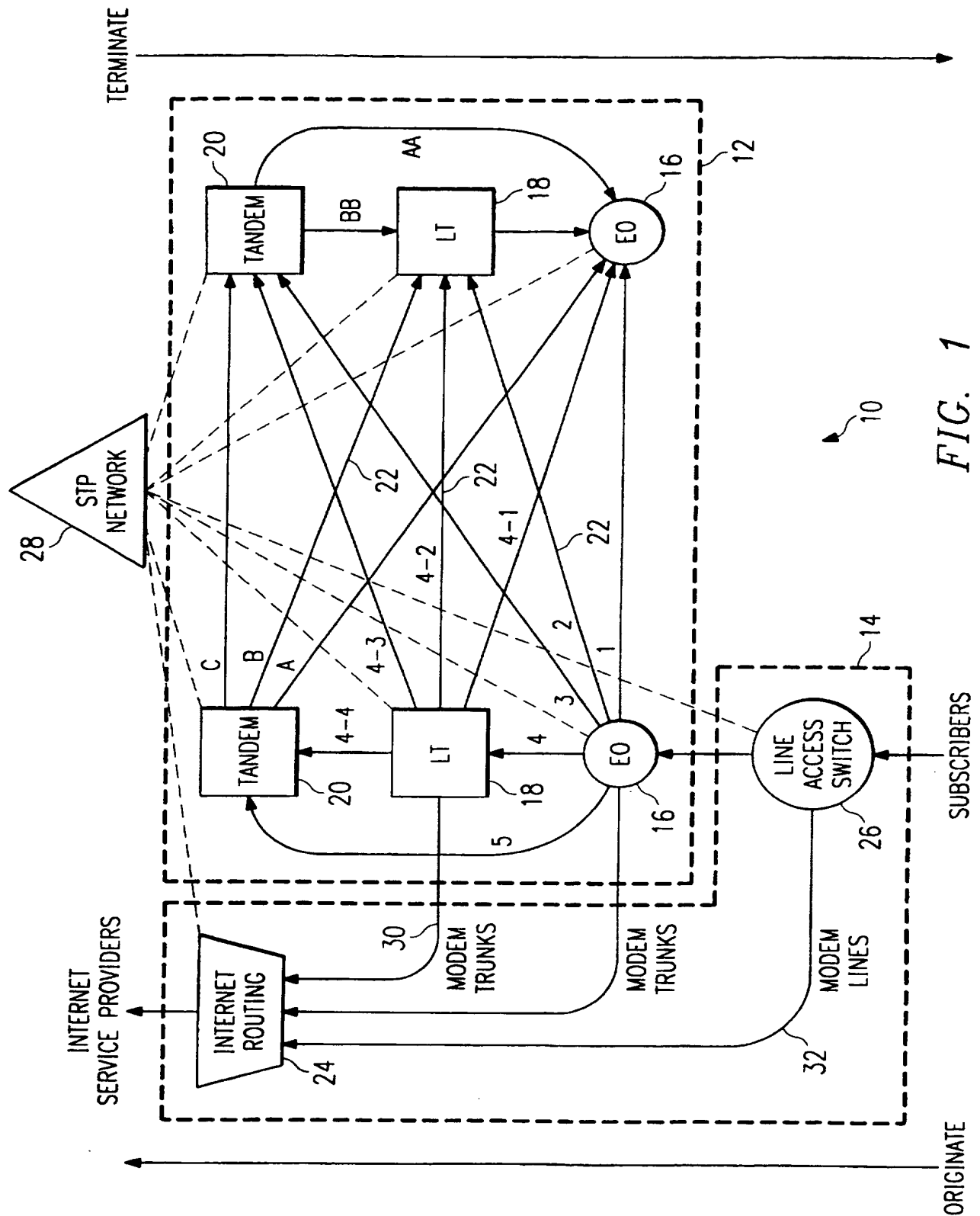


FIG. 1

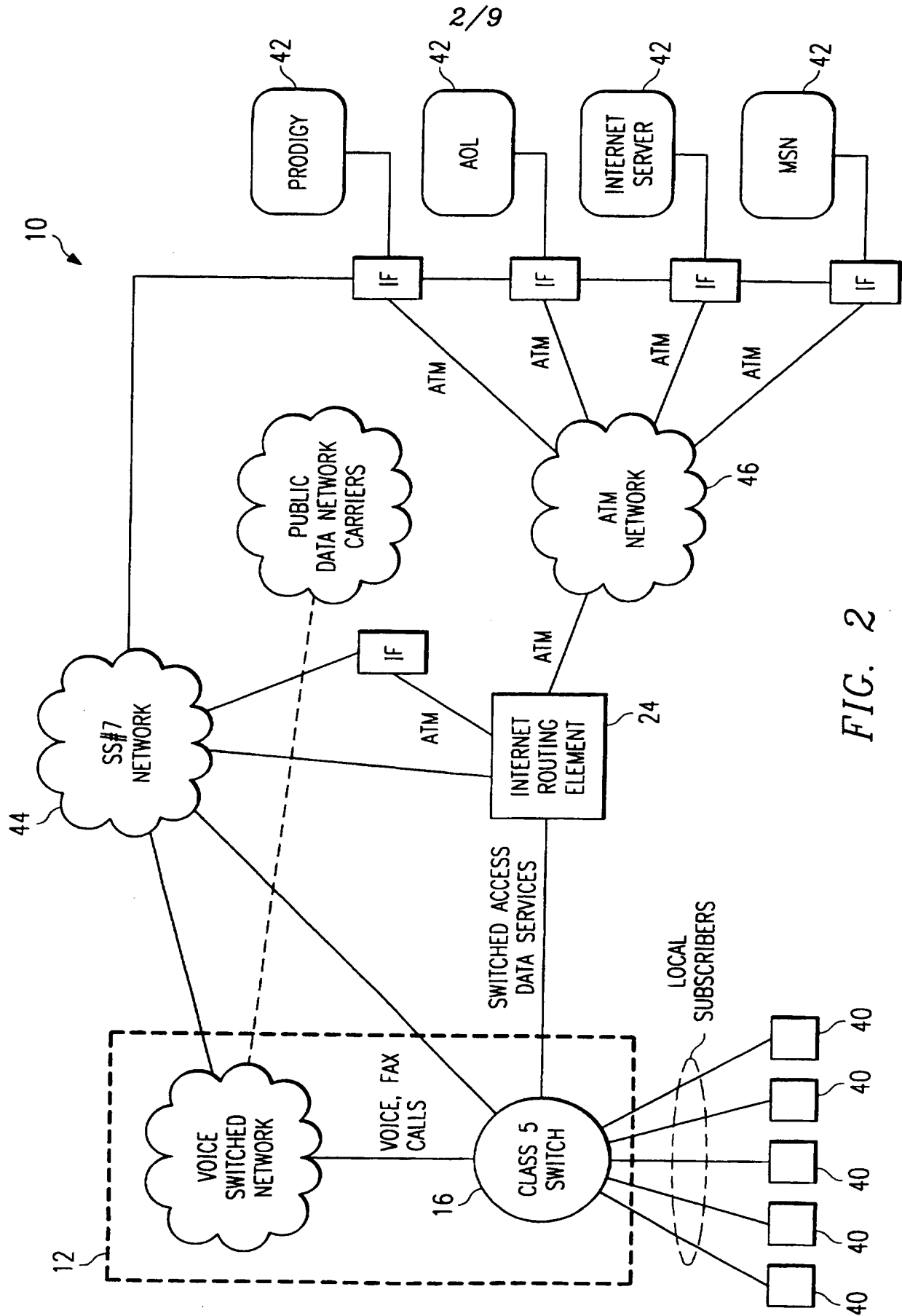


FIG. 2

3/9

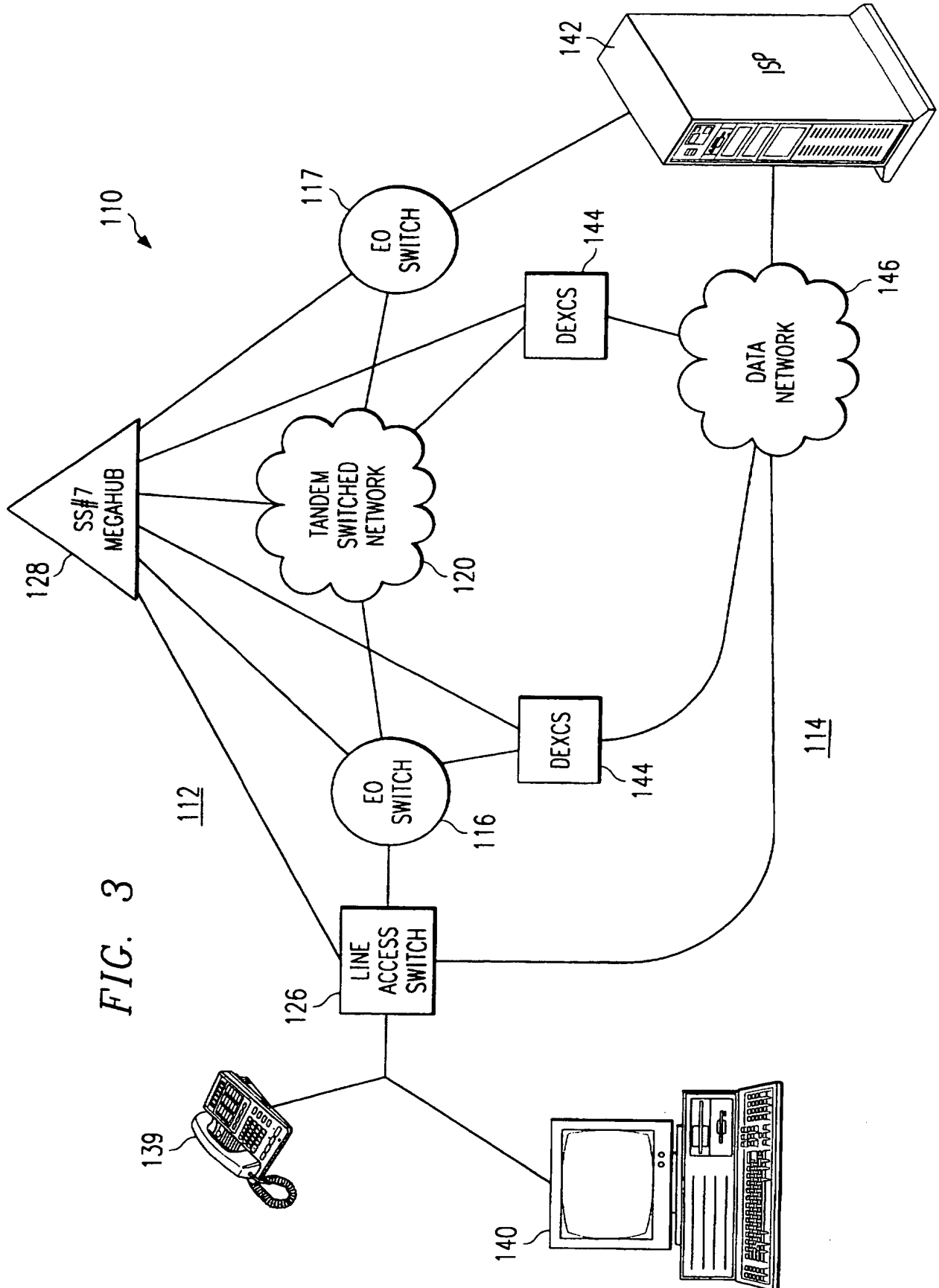
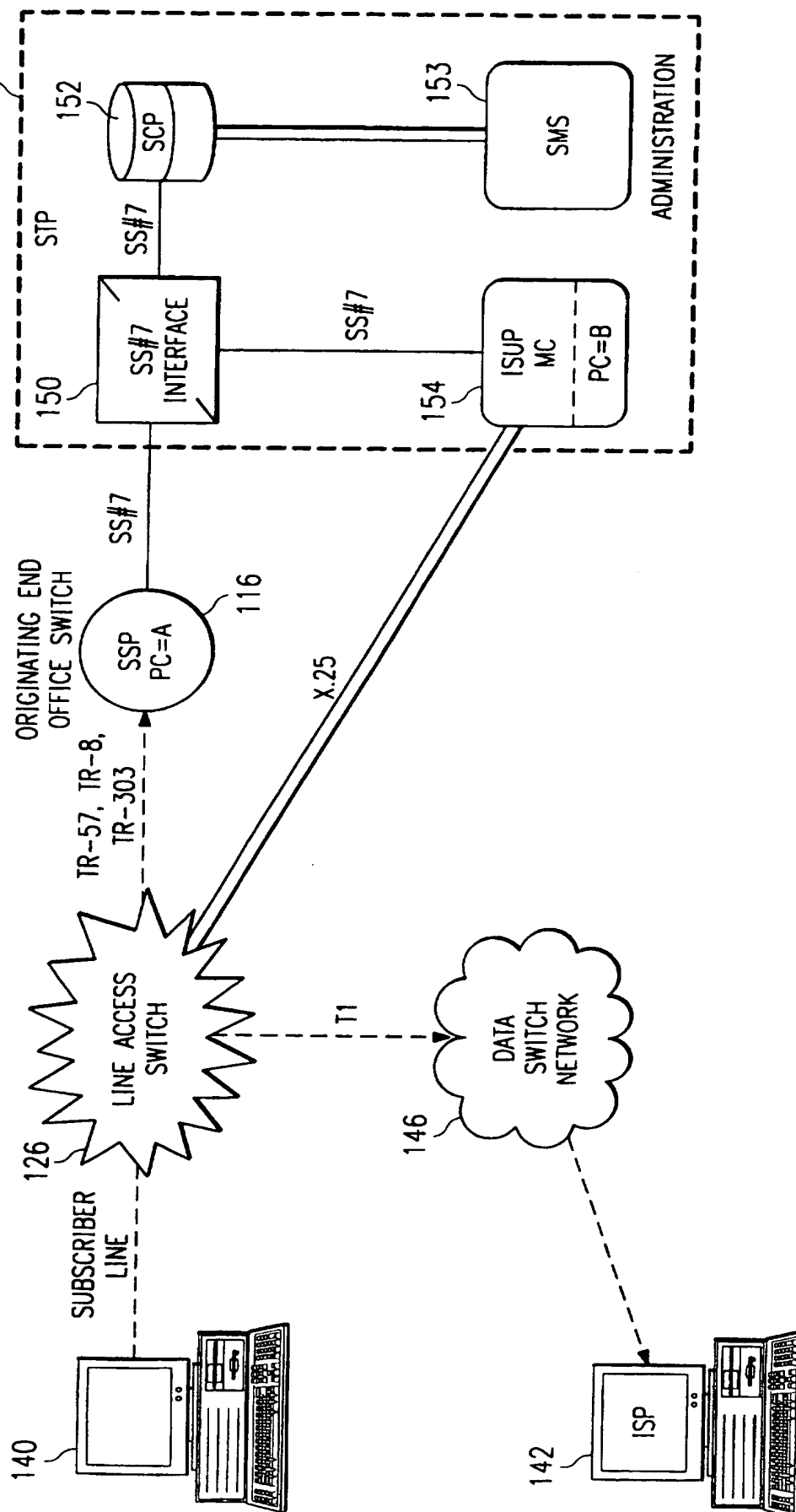


FIG. 3

4/9

FIG. 4A



5/9

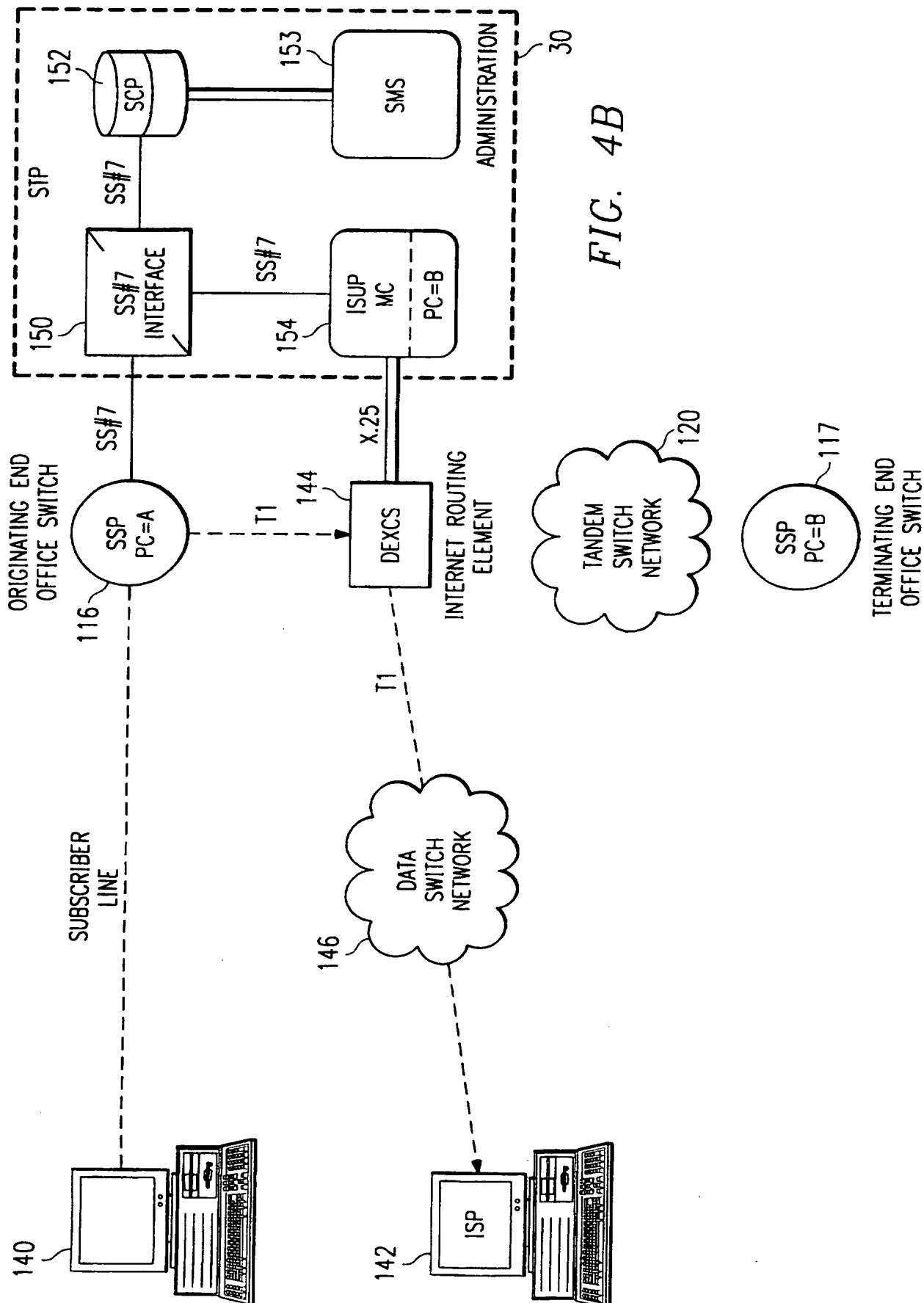


FIG. 4B

6/9

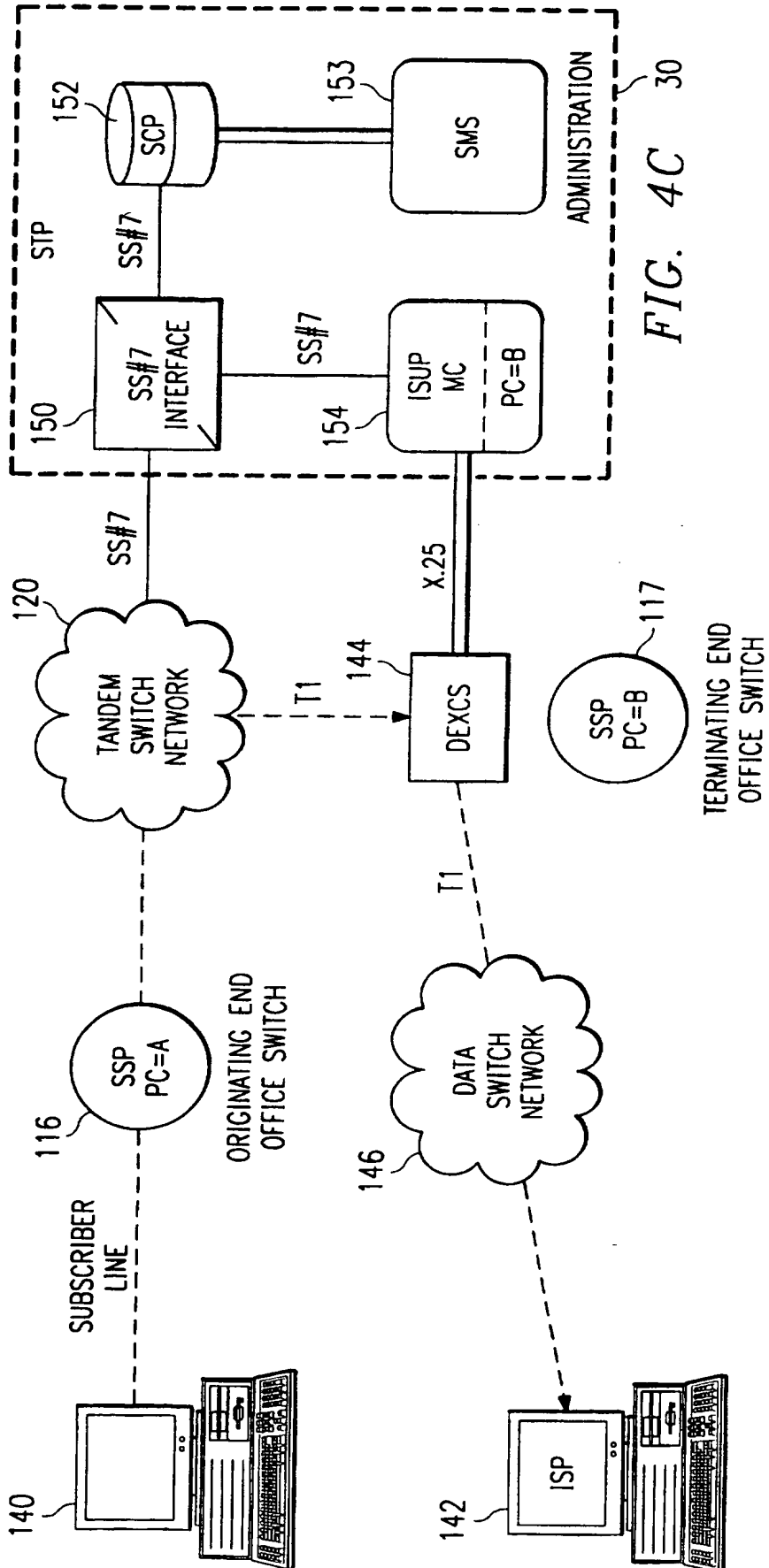


FIG. 4C 30

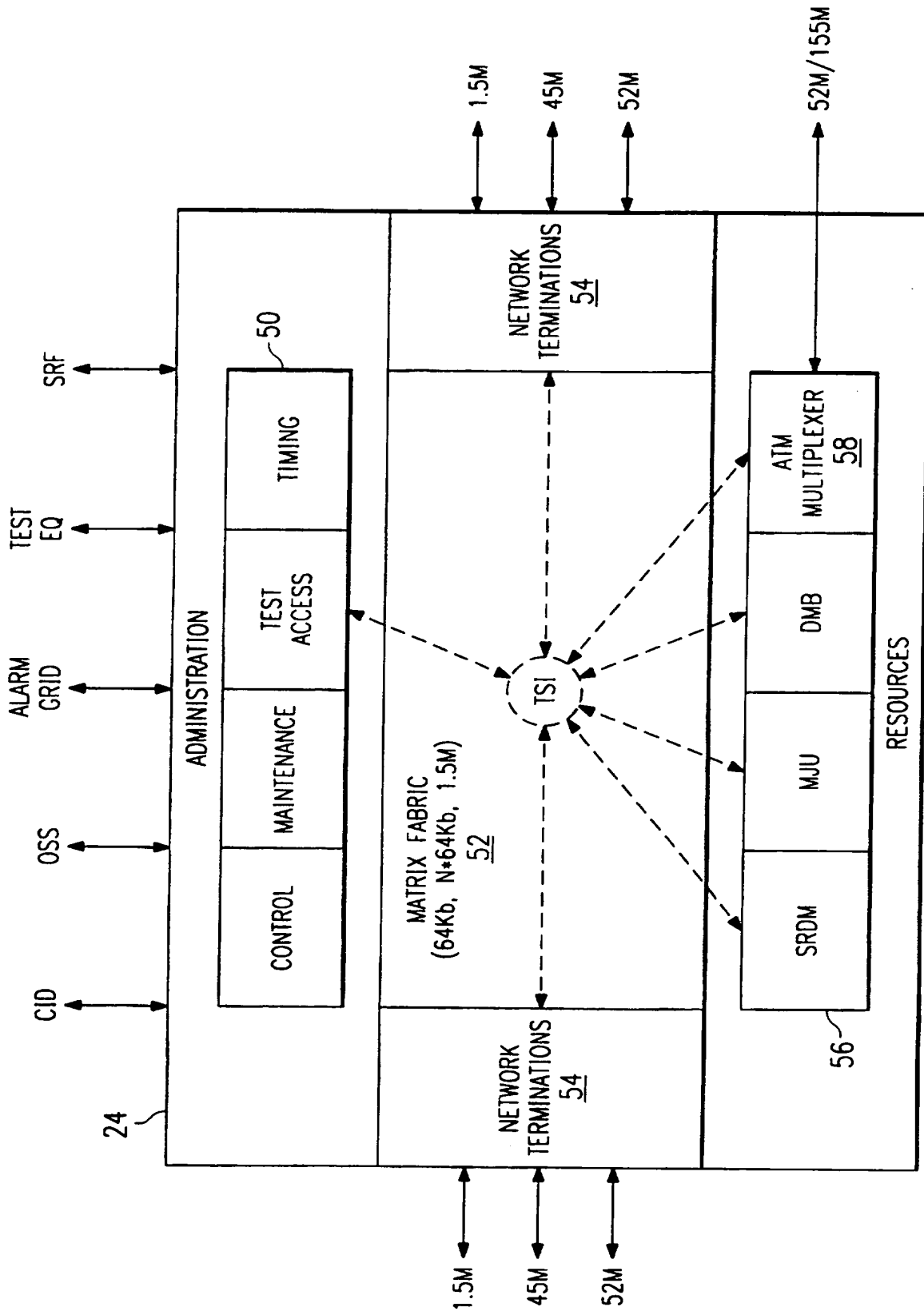
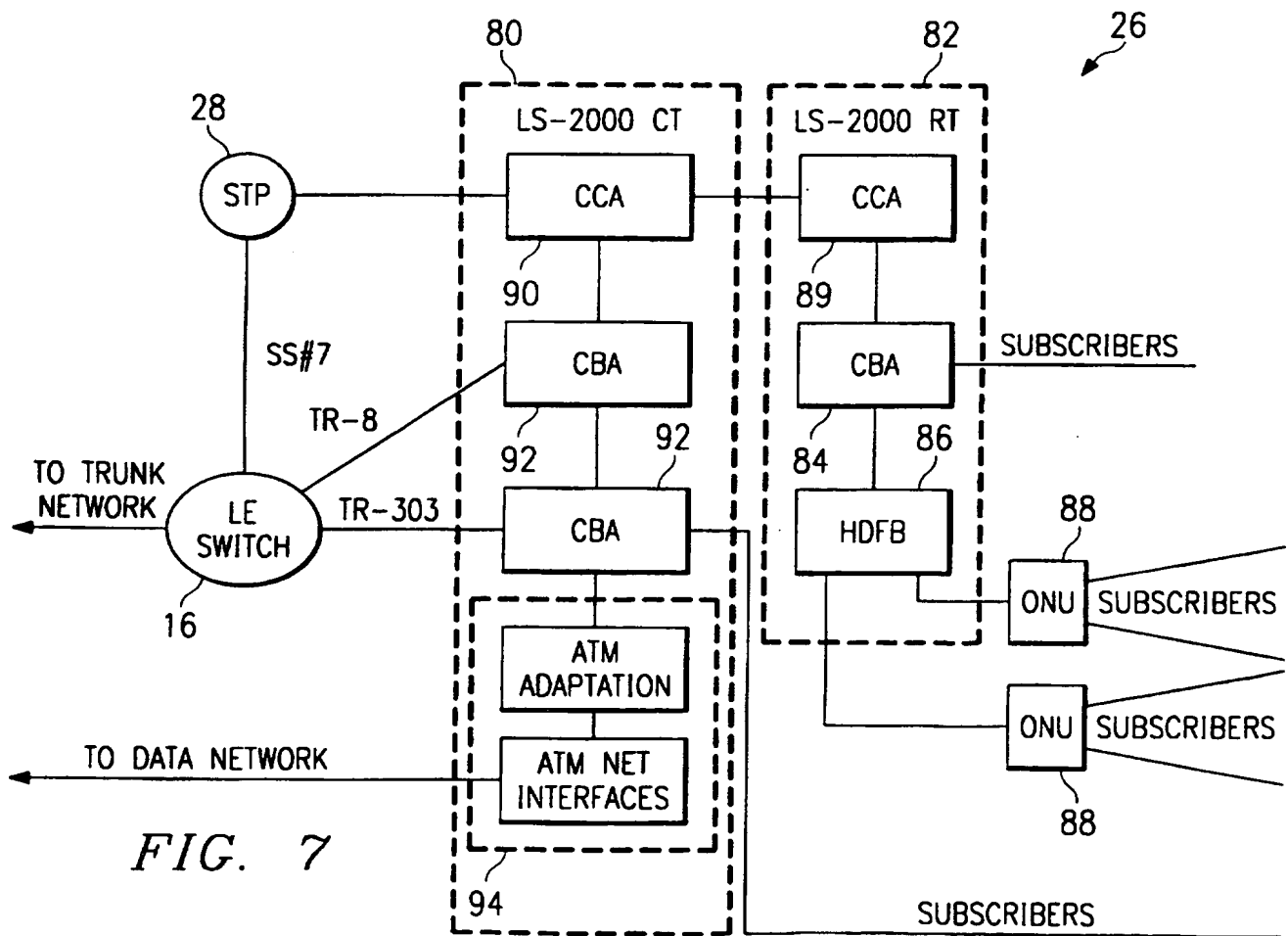
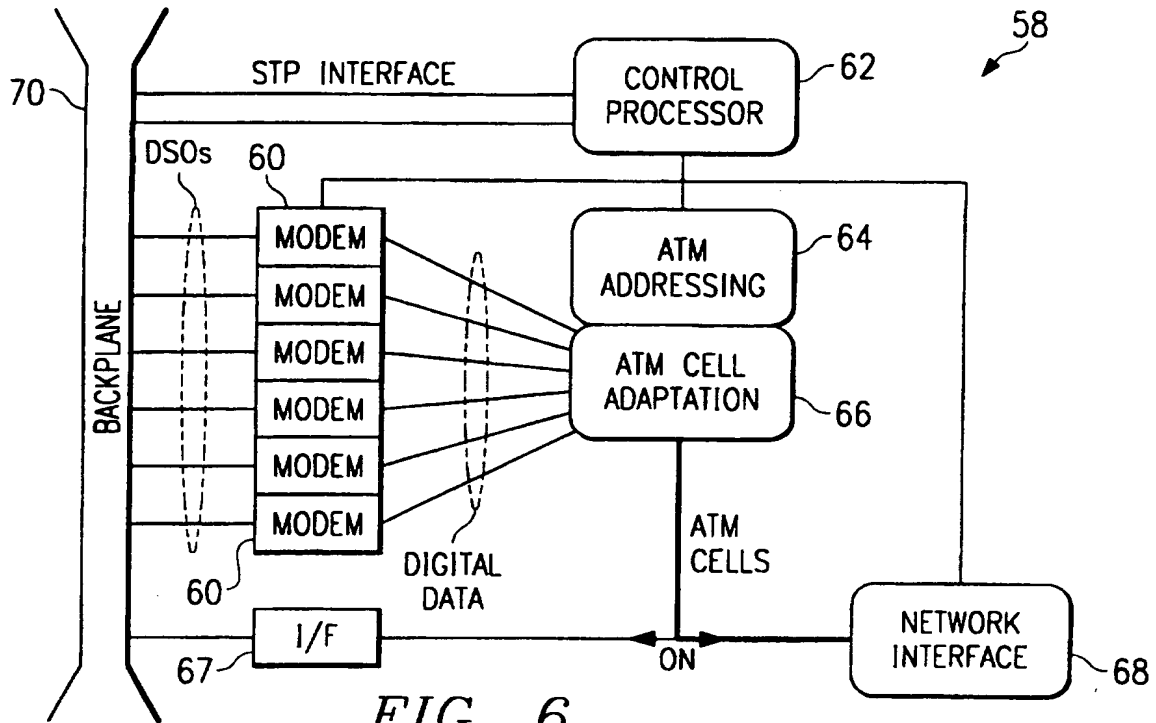
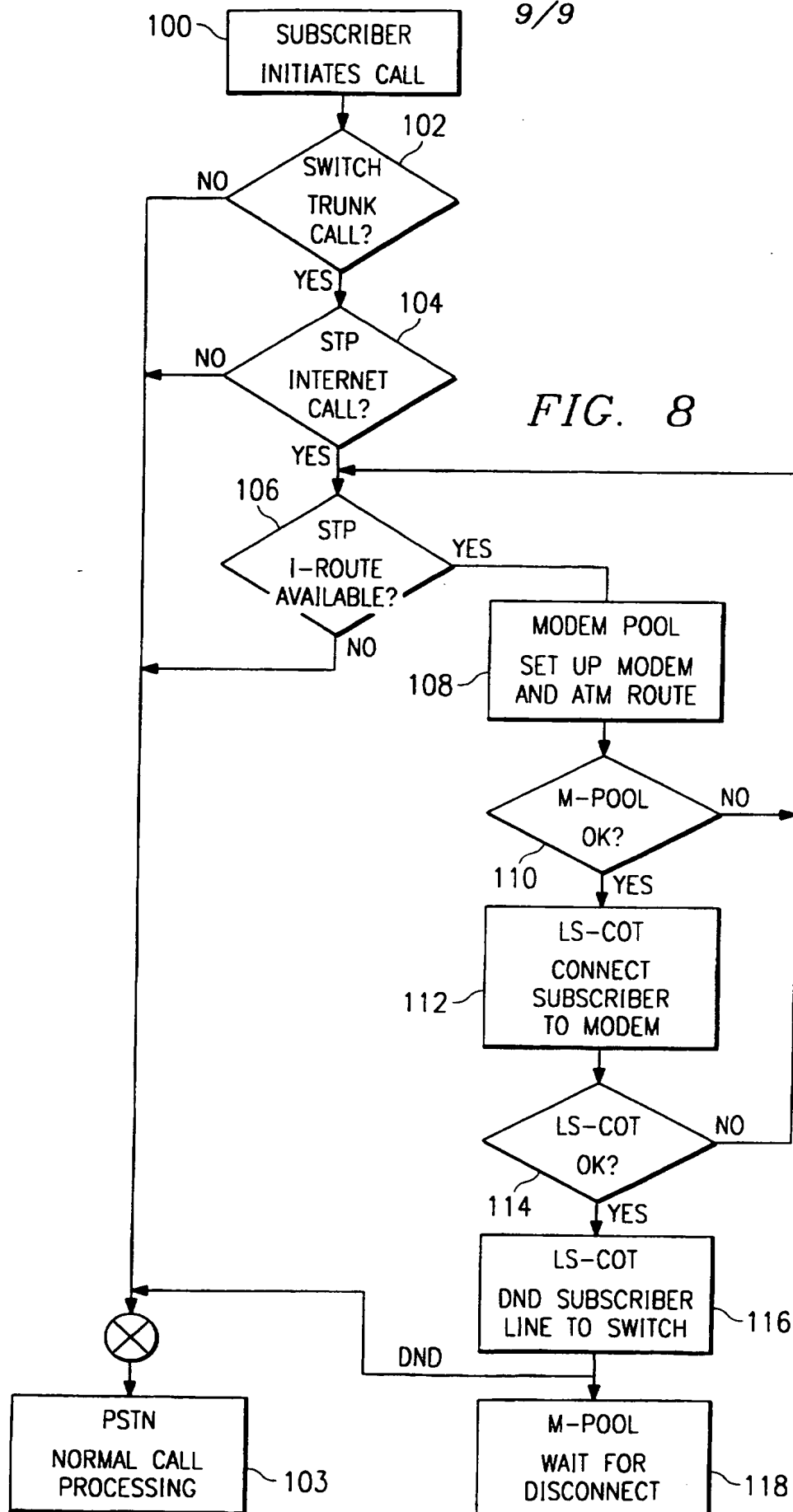


FIG. 5

8/9



9/9





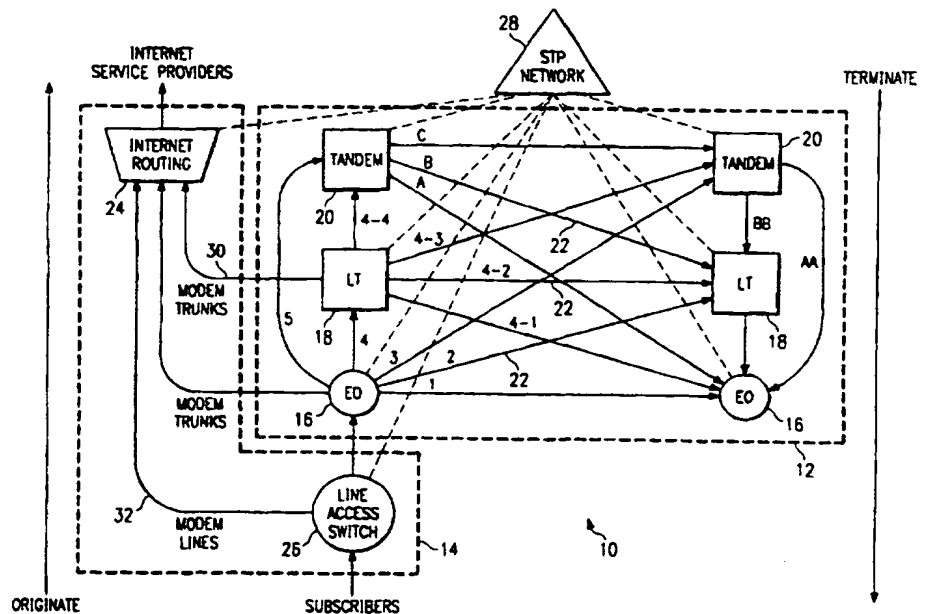
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 11/04, H04L 29/06		A3	(11) International Publication Number: WO 97/38551
			(43) International Publication Date: 16 October 1997 (16.10.97)
(21) International Application Number: PCT/US97/05387		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 1 April 1997 (01.04.97)		Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	
(30) Priority Data: 60/014,862 4 April 1996 (04.04.96) US 08/777,817 31 December 1996 (31.12.96) US		(88) Date of publication of the international search report: 20 November 1997 (20.11.97)	
(71) Applicant: DSC TELECOM L.P. [US/US]; 1000 Coit Road, Plano, TX 75075 (US).			
(72) Inventors: DESCHAIINE, Stephen, A.; 3326 Bluffview, Garland, TX 75043 (US). TRAUPMAN, Edward, P.; 490 Hackberry Drive, Fairview, TX 75069 (US). WARD, Ronald, L.; 3823 Ridgcrest Drive, Flower Mound, TX 75028 (US). HAGER, Kevin, W.; 3324 Jameston Drive, Flower Mound, TX 75028 (US).			
(74) Agent: FISH, Charles, S.; Baker & Botts, L.L.P., 2001 Ross Avenue, Dallas, TX 75201-2980 (US).			

(54) Title: METHOD AND APPARATUS FOR ROUTING INTERNET CALLS

(57) Abstract

A telecommunications network (10) includes a public switched telephone network (12) and an Internet data network (14). The Internet data network (14) includes an Internet routing element (24) and a line access switch (26). The Internet routing element (24) is coupled to end office switches (16) and local switches (18) of the public switched telephone network (12) by modem trunks (30). The modem trunks (30) provide the Internet routing element (24) with Internet calls re-routed from the public switched telephone network (12) to prevent the Internet calls from congesting trunks (22) of the public switched telephone network (12). The Internet calls are received at an ATM multiplexer (58) within the Internet routing element (24). The ATM multiplexer (58) includes a pool of modems (60) that converts the analog signal on the modem trunks (30) into digital data. The ATM multiplexer (58) includes an ATM cell adaptation unit (66) that converts the digital data into ATM cells for transmission to an Internet Service Provider (42) over an ATM network (48). The ATM multiplexer (58) generates addressing information for the ATM cells through interworkings with signaling protocols of a signal transfer point network (28) and an SS-7 signaling network (44) in order to determine the destinations for the Internet calls. The line access switch includes a similar ATM multiplexer (94) to re-route Internet calls prior to entering the public switched telephone network (12).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/05387

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q11/04 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04L H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 31060 A (MOTOROLA INC) 16 November 1995 see page 5, line 20 - line 34; figure 4 ---	1-16
A	WO 90 12466 A (BELL COMMUNICATIONS RES) 18 October 1990 see page 12, line 5 - line 27 -----	1-16

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

2 October 1997

Date of mailing of the international search report

13.10.97

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, T.x. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Veen, G

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 97/05387

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9531060 A	16-11-95	AU 2128995 A ZA 9503607 A	29-11-95 03-01-96
WO 9012466 A	18-10-90	US 4996685 A CA 2005734 A EP 0466696 A	26-02-91 10-10-90 22-01-92